

Fundamentals of Nanotechnology

Nanotechnology · Answer Key · 15 Questions

1. What is the approximate size range of objects defined as 'nanoscale'?

- A) 1 to 100 micrometers
- B) 1 to 100 nanometers**
- C) 100 to 1000 nanometers
- D) 0.1 to 1 nanometers

2. Which material is an allotrope of carbon consisting of a single layer of atoms arranged in a two-dimensional honeycomb lattice?

- A) Fullerene
- B) Diamond
- C) Graphene**
- D) Carbon Nanotube

3. What is the primary reason gold nanoparticles appear different in color (e.g., red or purple) compared to bulk gold?

- A) Surface plasmon resonance**
- B) Chemical oxidation
- C) Increased density
- D) Radioactive decay

4. Scanning Tunneling Microscopy (STM) is primarily used for which purpose in nanotechnology?

- A) Measuring electrical resistance of fluids
- B) Imaging and manipulating individual atoms**
- C) Calculating the atomic mass of molecules
- D) Determining the crystal structure of large metals

5. Which phenomenon describes the increase in a material's surface area to volume ratio as its particle size decreases?

- A) Quantum confinement
- B) The scaling effect**
- C) Thermal expansion
- D) Surface energy saturation

6. What are 'buckyballs' (Buckminsterfullerenes) chemically composed of?

- A) 60 atoms of silicon
- B) 60 atoms of carbon**
- C) 60 atoms of gold
- D) 60 atoms of nitrogen

7. Which of the following is a common application of silver nanoparticles in consumer products?

- A) Reinforcing structural concrete
- B) Improving electrical conductivity in copper
- C) Providing antimicrobial properties**
- D) Increasing the hardness of glass

8. What happens to the band gap of a semiconductor as its size reaches the nanometer scale due to quantum confinement?

- A) It remains constant
- B) It decreases
- C) It increases**
- D) It disappears entirely

9. Titanium dioxide nanoparticles are widely utilized in sunscreen due to their ability to perform which function?

- A) Reflect or absorb ultraviolet radiation**
- B) Chemically react with skin oils
- C) Generate heat to kill bacteria
- D) Provide a waterproof barrier through polymerization

10. What is the main challenge in 'bottom-up' nanotechnology manufacturing?

- A) The lack of raw materials
- B) Controlling the precise assembly of individual atoms**
- C) The extreme heat required for fusion
- D) The inability to use carbon-based materials

11. Which term refers to the method of creating nanostructures by removing material from a larger block?

- A) Self-assembly
- B) Top-down fabrication**
- C) Molecular deposition
- D) Chemical vapor synthesis

12. Superhydrophobic surfaces, such as those inspired by the lotus leaf, often rely on which nanostructure property?

- A) Atomic smoothness
- B) Nano-scale surface roughness**
- C) Increased chemical polarity
- D) Magnetic attraction to water

13. What is a carbon nanotube characterized as?

A) A long, hollow cylinder of graphene

B) A sphere of bonded carbon atoms

C) A thin sheet of diamond

D) A stack of graphite layers

14. Ferrofluids are colloidal liquids made of nanoscale ferromagnetic particles suspended in a carrier fluid. How do they respond to a magnetic field?

A) They turn into gas

B) They change color

C) They form spike-like patterns

D) They become electrically insulating

15. In the context of nanotechnology, what does the acronym 'MEMS' stand for?

A) Molecular Electronic Measurement Systems

B) Micro-Electro-Mechanical Systems

C) Macro-Engineering Materials Science

D) Minimal Energy Molecular Structures